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On the distance travelled for woodland leisure via different transport modes in Wallonia, south Belgium

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ABSTRACT

Based on an extensive survey of woodland visitors in Wallonia, south Belgium, we examined a wide range of individual-, residential- and destination-level variables for their associations with the distance travelled for woodland leisure on foot, by bicycle and by car. For each transport mode, explanatory bivariate analyses were conducted firstly to identify potential correlates of the distances travelled. Then, cross-classified multilevel analysis was performed to build estimation models for the trip distance. The results showed that, amongst the multilevel variables selected, walking trip distance was only associated with individual trip behaviour, while cycling and car-borne trip distance could also be associated with individual socio-economic profile as well as a large range of residential and destination attributes on land use, land cover and visitor support services. The final estimation model for (i) walking trip distance included trip duration as the only explanatory variable, for (ii) cycling trip distance included variables on trip duration, proportion of woodland area at residence and presence of service facilities at destination, and for (iii) car-borne trip distance included variables on trip duration, visitor's employment status, whether the trip is on weekend or in summer, proportion of woodland area at residence and remoteness of destination from urban area. Despite being simple in form, all multilevel estimation models show a satisfactory explanatory power and a better performance than the ordinary single-level models. Our results add new empirical evidences on the key factors associated with the transport mode-specific travel distance, in particular, for woodland leisure. The cross-classified multilevel analysis used in our study provides new methodological insights for the estimation of individual trip distance, which could benefit future modelling of woodland recreation demand.

1. Introduction

Woodlands are a multi-functional ecosystem type that can offer a broad range of leisure opportunities, including relaxation walk, nature observation, and orienteering, to name a few. Such opportunities motivate people to visit woodland and stimulate expenditures in travel (Zandersen and Tol, 2009). Besides, viewing natural landscapes in woodland is found to be beneficial to people both for short-term recovery from mental stress and physical illness and for long-term improvement of overall health and well-being (Velarde et al., 2007). While the potential economic and health values of woodland are well recognised, little is known on the determinants and characteristics of woodland leisure trips.

Woodland leisure has a strong tradition in many countries of Europe. In Wallonia, a previous regional telephone survey suggested approximately 45% of the population would visit woodland for leisure purpose, among which 70% visit woodland more frequently than five times a year (Colson, 2006). Although this proportion can be lower than the Nordic countries (e.g. Finland, Sweden), it still implies a high human population pressure on local woodlands as Belgium is comparatively very densely populated. Understanding the key processes underpinning the woodland trip patterns would support communications between tourism

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planners, woodland managers, and public health professionals. Current studies in woodland leisure mainly focus on the identification of the profiles, preferences and satisfactions of visitors (Hörnsten and Fredman, 2000; Roovers et al., 2002; Colson, 2006, 2007), or the quantification of woodland leisure values (Colson, 2009; Zandersen and Tol, 2009; Bujosa Bestard and Riera Font, 2010; Colson et al., 2012). There is a crucial need to understand better the key factors of individual travel behaviours and decision making mechanisms, which underpin the dynamics of regional trip pattern.

In general, the distance travelled can be regarded as a key determinant of expenditures and destination choice (Wynen, 2013), and is largely included as an important variable in travel demand analysis and modelling. Previous studies have put a specific emphasis on the distances travelled for working or business (Cao et al., 2009; Ohnmacht et al., 2009; Ewing and Cervero, 2010; Wynen, 2013). Distance travelled for outdoor recreations has been less studied, particularly for leisure activities in woodlands. Existing investigations on distance travelled for leisure activities consider factors from multiple contexts, including individual-level characteristics, such as socio-demographics and travel behaviours (Mercado and Páez, 2009; Barbieri and Sotomayor, 2013), and other levels such as residential-level land use patterns and destination-level visitor support services (Dieleman et al., 2002; Limtanakool et al., 2006; Nicolau and Más, 2006; Barbieri and Sotomayor, 2013; Feng et al., 2013). While most of these existing studies adopted ordinary single-level analysis, multilevel models (also referred to as hierarchical or mixed models) seem more promising. They allow investigators to (i) identify the variables at each level associated with the dependent variable, (ii) determine the relative importance of each level and (iii) capture variability between individuals and between levels (Hox, 2002; Goldstein, 2011). Multilevel modelling has shown advantages by shedding additional light on contextual clustering of the data and its effects in a number of recent applications in travel behaviour studies, for example, on the daily trip distances and trip numbers in Italy (Bottai et al., 2006), on the mean trip distances (total distance travelled/total number of trips) of elderly people in Canada (Mercado and Páez, 2009), and on the residential location and daily travel distances in Sweden (Elldér, 2014).

This work was drawn from the empirical data collected in Wallonia by Colson (2007) and put specific focus on the distance travelled which is an important variable in the analysis and modelling of travel expenditure and destination choice but has rarely been addressed for woodland tourism. Our main objectives were (i) to identify the factors associated with the distance travelled for woodland leisure via major modes of transport in Wallonia, and (ii) to check the cross-level interactions of individual (socio-demographic profile and trip behaviours of visitors), residential (population density, land use and land cover) and destination (land uses, land cover and visitor support services of woodland tracts) attributes, as well as their associations with the individual woodland trip distance. The secondary objective was to develop travel-mode specific distance estimation functions that could potentially be used in regional models for travel demand in forest, e.g., a recently developed model for woodland visitation dynamics (Li et al., 2015), to better their explanatory and predictive power.

2. Methods

2.1. Study area

The Walloon region of Belgium has an overall population density of around 200 inhabitants per km^2. The population is mainly concentrated in the northern areas, following the industrial axis formed in the 19th century, running from east (Liège) to west (Mons). Woodlands (5400 km^2) occupy approximately 30% of the Walloon territory. These woodlands are mainly distributed in the central and southern parts of the region, relatively far from the major cities. More specifically, about 75% of the woodland patches in Wallonia were rural, leaving 4% and 21% located in urban and peri-urban areas, respectively.

2.2. Cross-classified multilevel analysis

Multilevel models assume a hierarchical structure in the data with a single dependent variable measured at the lowest level and independent variables at all existing levels (Hox, 2002). When considering such a multi-contextual structure of data and variables, single-level models are less preferred because they may fail to account for the dependency of observations within levels (or contextual clusters) and, hence, may lead to fallacies and wrong conclusions (Snijders and Bosker, 1999). The multilevel structure considered in this study could be sketched as woodland visitors (level 1) nested within groups (or contextual clusters) of residencies (level 2) and woodland tracts (level 3). It was clear that level 2 and 3 units do not equate to each other, resulting in a cross-classified structure where level 1 units nest within crossing combinations of units at the two higher levels. It is important to incorporate such a structure into our model, as ignoring any contextual clusters may result in misleading conclusions about the relative influence of the sources on the outcome (Leckie, 2014).

In this study, a number of factors potentially associated with the distance travelled for woodland leisure were selected (Fig. 1), with profiles and travel behaviours of visitor at a lower level, and characteristics of municipalities of residence and woodland cross-classified at upper levels.

2.3. Individual level variables

The individual level information was drawn from survey data (Colson, 2007). From October 2005 to August 2006, a survey was carried out in 40 forests of Wallonia via face-to-face interviews. There were 2620 survey participants from Wallonia, representing 64.7% of the total participants. Survey participants from Flanders and Brussels were 20.0% and 4.5% respectively. A small proportion of the participants were from neighbouring countries such as Germany (6.9%), France (2.3%) and the Netherlands (0.2%). The rest (1.4%) did not provide residential information. The distribution of Walloon survey participants in their origins and destinations are mapped in Fig. 2. Amongst the 40 survey sites, there were 4 urban and 10 peri-urban woodland tracts which contributed to 16.6% and 32.1% of total survey participants. Only participants from Wallonia were included in the analysis, as the residential level information was missing for residents from neighbouring regions. In the next step, three subsets were extracted from the data according to the different modes of transport recorded in the survey: (i) walking trips (N = 420), for those who travelled on foot only (e.g. walking, hiking and jogging), (ii) cycling trips (N = 282), for those who travelled by bicycle only, and (iii) car-borne trips (N = 1672), for those who used car for transportation.

The dependent variable considered was the distance travelled by individuals between their municipality of residence and the woodland tract concerned, being calculated based on the geographical coordinates of origin and destination. The centroid coordinates of the postal zones were used as the coordinates of origin. The histograms of distances travelled in general and via different transport modes are presented in Fig. 3. A preliminary analysis showed that most distances travelled were shorter than 50 km (88.7%), and only a few visitors travelled further than 100 km (2.5%). A logarithmic